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Country Assessments and the IAEA Milestones Process

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In a speech delivered at the United Nations General Assembly in October 2008, the Director General of the International Atomic Energy Agency, Mohammed ElBaradei, noted that "In the last two years, some 50 Member States have expressed interest in considering the possible introduction of nuclear power and asked for Agency support."[2] To address the explosion of interest in nuclear power among non-nuclear Member States, the IAEA published in 2007 a report titled "Milestones in the Development of a National Infrastructure for Nuclear Power" ("Milestones Report") to serve as a guidance document and as a comprehensive, beginning-to-end strategy document for policymakers and implementing parties alike. As a supporter of the safe and secure global expansion of nuclear power, the United States government, particularly the U.S. Department of Energy (DOE), has embraced the "Milestones Process," which has been integrated into the 2009 Program Plan of Infrastructure Development Working Group (IDWG) of the 25-member Global Nuclear Energy Partnership (GNEP).

The Milestones Report guides countries through phases for three key milestones, from the earliest point of committing to the concept of pursuing nuclear power to the actual start of operation of a nuclear power plant. Specifically, these milestones are:

1. To make a knowledgeable commitment to a nuclear program.
2. To invite bids for the first nuclear power plant.
3. To commission and operate the first nuclear power plant.

Furthermore, the Milestones Report identifies 19 critical infrastructure issues, each of which is measured against progress made in each phase of the three milestones. These infrastructure issues are:

1. National position
2. Nuclear safety
3. Management
4. Funding and financing
5. Legislative framework
6. Safeguards
7. Regulatory framework
8. Radiation protection
9. Electrical grid
11. Stakeholder involvement
12. Site and supporting activities
13. Environmental protection
14. Emergency planning
15. Security and physical protection
16. Nuclear fuel cycle
17. Radioactive waste
18. Industrial involvement
19. Procurement

[1] *This work performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.*
[2] ElBaradei, Mohammed, "Statement to the Sixty-Third Regular Session of the United Nations General Assembly," October 28, 2008.

10. Human resource development

The country-assessment process may consist of evaluating progress for each of the 19 infrastructure issues for each Milestone with respect to the specific guidance provided in the Milestones Report. However, the breadth of an analysis may be tailored to specific issues that the country is or anticipates facing. As we note later in this report, our first case study, performed for the partner state of Jordan, consisted of an assessment for all infrastructure issues for each Milestone. This was a considerable undertaking. It appears that our next assessment will be considerably smaller, a "pre-assessment" confined to a few selected infrastructure issues for just the first of the three Milestones, for the partner state of Ghana.

Across all infrastructure issues for all Milestones, the IAEA has identified more than 200 criteria that we, in turn, integrated into an assessment template. On a case-by-case basis, we provide high-level analysis for each of these criteria, noting the status of any one particular criterion as complete (noted by a checkmark; "✓"), incomplete ("INC"), underdetermined ("UND")[3] or contingent ("CON")[4].

The template:

Milestones Infrastructure Issue No. 6 — "Safeguards"

Milestone 1 — Ready to make a knowledgeable commitment to a nuclear programme (criteria and status*)		**Milestone 2 — Ready to invite bids for the first nuclear power plant (criteria and status*)**		**Milestone 3 — Ready to commission and operate the first nuclear power plant (criteria and status*)**	
Obligations under NPT and non-proliferation treaties, including establishment of SSAC, recognized	**INC**	Terms of international safeguards agreement in place	✓	All safeguards measures and an effective SSAC in place before receipt of initial fuel loading	**CON**
Implementation and enforcement of safeguards legislation	**INC**	State system of accounting for and control of nuclear materials established and	**INC**	Information regarding fuel cycle and all relevant nuclear material subject to	**CON**

[3] For those activities listed as "undetermined" as well as for areas that we have assessed imprecisely, we expect to work with our counterparts to determine a more accurate assessment.

[4] For those activities listed as "contingent," we do not believe that these activities can be addressed or satisfied without the respective country taking steps to address preceding activities, some of which may hold a status of "incomplete." For example, under the infrastructure issue *funding and financing,* one criterion under Milestone 1 reads "Socio-political acceptance" and another closely related criterion under Milestone 2 reads "Reasonable degree of socio-political acceptance obtained." In our analysis, we may mark the criterion under Milestone 1 as "INC" for incomplete. Because we believe a country would be unable to satisfy the criterion under Milestone 2 before satisfying the related criterion under Milestone 1, we mark the criteria under Milestone 2 "CON" for contingent because satisfying this criterion is contingent upon the state satisfying the related criteria under Milestone 1.

planned		operational		safeguards instruments provided to IAEA	
		Early safeguards relevant information provided to IAEA	UND		
		Specific legislation and relevant safeguards procedures are in place	INC		

*The status of each criteria falls into one of four potential categories — complete ("✓"), incomplete ("INC"), undetermined ("UND") or contingent ("CON").

The benefit of using the Milestones Process as the basis for evaluating nuclear-infrastructure development in a country is that it presents a high-level status report of progress across multiple areas and, as a result, the simple identification of current or soon-to-be challenges that may initiate offers of assistance from a partner state such as the United States. In our effort in Jordan, we made 15 practical recommendations based on this approach and identified 18 areas where specific bilateral collaboration could support these recommendations.

It is important to note that this approach has its limitations in that an analysis at this level is not "in-depth" and has fixed utility. All parties involved need to understand this from the onset. However, our approach has been to supplement a broader, Milestones-based analysis with issue-specific study identified, discussed, performed and reviewed with and for the partner state. In terms of subject matter, DOE leverages the expertise that exists at the national laboratories in order to support detailed analyses of any infrastructure issue. In terms of practice, Argonne National Laboratory has performed such an analysis for Jordan on the cogeneration of power for electricity and desalination and on suitable funding and financing approaches for nuclear power development.

OBSERVATIONS

In our experience, we believe the Milestones Process is a sound approach to evaluating nuclear-infrastructure progress. We wish to contribute the following observations.

First, there is an interrelationship within the 19 infrastructure issues and therefore the issues are not mutually exclusive. This presents a challenge when evaluating each specific issue on its own as progress in any one infrastructure issue may be dependent on progress in one or more separate infrastructure issues. For example, it is not possible to evaluate independently the infrastructure issues *security and physical protection* or *emergency planning* because, as noted, progress on each depends on the development of a robust legal and regulatory foundation, which are separate infrastructures issues *legislative framework* and *regulatory framework.*

Conversely, it is possible for a country to advance through the Milestones of a given infrastructure issue without reaching a Milestone for other infrastructure issues. In other words, where some infrastructure issues may have some degree of interdependency, others have none. For example, a country may be able to advance through all three milestones of the infrastructure issue area *legislative framework* without establishing a position on the issue area *procurement.*

Second, the relative importance of the 19 infrastructure issues is not equal and will likely vary, perhaps greatly, depending on the country involved. Although we concur with the emphasis and importance that the IAEA places on issues such as *stakeholder involvement*, policymakers may not assign this infrastructure issue with an equal importance to *funding and financing* for a particular country.

Third, the "achievability" of each Milestone may differ greatly. States may not encounter a significant challenge in meeting certain criteria for Milestone 1, which often call upon states to "identify," "establish," "recognize," or "evaluate" a task or need, where as criteria for Milestone 2 call upon states to "fund," "implement," "enact," "adopt," and "provide for." States need to recognize that the achievability of Milestones for many infrastructure issues could become increasingly difficult, particularly with respect to transitions from Milestone 1 to Milestone 2.

Fourth, and related to the previous point, the language selected to describe a particular criterion may leave the evaluation open to various interpretations. For example, in the first infrastructure issue *national position,* a criterion in Milestone 1 reads "safety, security and nonproliferation needs recognized." If we are left with the impression that our counterparts understand the importance of this criterion, we may mark it as complete. However, others may prefer to see stronger supporting evidence, such as a policy statement, to support *recognition* of these needs. We find there are similar issues with action language such as "establish" and "survey." *Establish* does not provide any indication of effectiveness; *survey* does not provide indication whether a formal or informal survey can adequately satisfy a criterion. Furthermore, in some cases, we may rely on a first-hand report from our counterparts that a criterion has been met, which introduces again the possibility of inconsistent interpretation.

THE FIRST-OF-A-KIND CASE STUDY

In May 2009, the United States presented a 90+ page two-part report to government representatives from the country of Jordan, concluding an approximately 15-month process toward the completion of the first bilateral assessment of nuclear infrastructure development in a country using the Milestones Report.[5] The first part of the study was an analysis of nuclear infrastructure in Jordan and titled "Infrastructure Assessment Study on Potential Deployment of Nuclear Power in the Hashemite Kingdom of Jordan." The second part was a detailed analysis, referred to as a "Supplement" and titled "Economic Analysis, Cogeneration," which addressed issues such as capital costs and financing options for a nuclear power plant, the benefits of grid interconnectivity, the impact of storage and transportation of water, desalination technology options and open- vs. closed-loop nuclear plant cooling.

LESSONS LEARNED

[5] The contents of the report are not publicly available.

There are several lessons to be drawn from the first-of-a-kind assessment. Here we note three.

First, the entire process, from the point in February 2008 when DOE stated that it would support a collaborative assessment in Jordan to the transfer of the finished product in May 2009, took 15 months. This is far too long and presents a potentially critical problem. The information in a report, including information upon which analyses are performed, becomes quickly dated. This is particularly true in this industry in which the media reports of new government-to-government (e.g. memorandums of understanding, nuclear cooperation agreements) and government-to-vendor agreements on a seemingly daily basis. The shifting landscape may have an adverse impact by devaluing or rendering irrelevant the analysis, recommendations or proposals for collaboration or engagement. We recognize the need to perform assessments on a shorter timescale. To accomplish this, we have identified three steps that should greatly reduce the time to needed to complete the process. First, we will work with our counterparts to identify clear work requirements and deliverable specifications. Second, we will leverage the development of a comprehensive Milestones template to perform high-level analyses. Third, we plan for regular teleconference calls and, as necessary, in-country visits to meet and discuss developments and progress with our partners.

Second, we found two components of the review process to be immeasurably valuable. First, we shared for review our draft final reports with the interagency, namely with experts from DOE's Office of Nuclear Energy, DOE's National Nuclear Security Administration, the Department of State and the U.S. Nuclear Regulatory Commission (NRC). We received actionable feedback that served to make the report more concise (i.e. shorter) and relevant for our partner. Second, we shared this "new" draft with our counterparts in Jordan, who responded with valuable information on developments that had not been noted in the report and how these developments affected our assessment. Ultimately, this process allowed us to deliver a report that was acceptable to all parties while remaining accurate and true to the purpose.

Third, through our interactions with IDWG partners and observers, we learned that full, complete assessments may not be appropriate for all states interested in introducing nuclear power. By exhibiting flexibility in how we approach our assessments, we have found our process has become more appealing to potential "client" states, as well as to states that may wish to contribute expertise to the evaluation process. For example, we anticipate that our next assessment, working with our counterparts in the country of Ghana, will be considerably smaller than our Jordan study, perhaps evaluating just a few infrastructure issues at a pre-Milestone One phase.

NEXT STEPS

We see several opportunities to improve the country assessment process, which is critical as support for nuclear infrastructure development continues to build. We note a few areas that we have targeted.

- The IAEA has become a leading voice in nuclear infrastructure development. It has established a "Nuclear Energy Series," within which it publishes reports addressing specific infrastructure challenges, from the financing of new nuclear power plants to human resource considerations. Among the documents, the IAEA has published a follow-on report to the Milestones report (also

part of the Nuclear Energy Series) titled the "Evaluation of the Status of National Nuclear Infrastructure Development." This report provides states with a template on how to evaluate its infrastructure readiness for Milestones One and Two for each of the 19 infrastructure issues. In many respects, it is similar to the process that we have developed. As our first next step, we need to examine the IAEA approach and measure it against our approach. The purpose will be to understand the differences in each, identify shortcomings and improve or strengthen our process.

- The IAEA has also developed a process to review assessments that a state has either completed itself or with the support of one or more partners. The IAEA calls these Integrated Nuclear Infrastructure Review (INIR) missions and makes them available through formal requests via the IAEA Department of Technical Cooperation. We are interested in supporting these missions and would be interested in sitting as an observer on any mission, particularly on a mission in which the United States participated in the assessment process.

- The IDWG is exploring collaborative assessments in which more than one partner contributes to the process. In May 2009, the IDWG met for the fourth time in Manchester, England, and discussed the idea of a multilateral approach to an assessment scheduled in the 2010 timeframe. Although there are challenges to overcome, early indications are that several states, including advanced nuclear states, are interested in participating.